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ABSTRACT

During the past decade, several European countries invested heavily in research and development (R&D), including building world-class laboratories and other facilities and expanding higher education in science and engineering. This document summarizes the report, Human Resources for Science and Technology: The European Region, that presents data on the rapid growth of academic degrees and R&D financial support. The data in this brief indicate that a high concentration of the world's scientific resources continues to reside in Europe. Particularly noteworthy is the increase in the awarding of natural science and engineering (NS&E) degrees by institutions in Western and Central European countries. In addition, European and Asian institutions awarded a higher percentage of all their undergraduate degrees in NS&E fields than U.S. universities and colleges. Other findings include that Western European civilian research approaches that of the United States, and the amount of funds spent on research performed at academic institutions in Western Europe now equals that spent at U.S. universities and colleges. It is concluded that as the capacity to perform R&D expands throughout the world, it is increasingly important for the United States to be knowledgeable about the scientific and technological accomplishments of other world regions. (JRH)

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DATA BRIEF

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Western Europe Leads the United States and Asia in Science and Engineering Ph.D. Degree Production

by Jean M. Johnson

The European Union gives high priority to investments in science and technology.

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During the past decade, several European countries invested heavily in research and development (R&D), including building world-class laboratories and other facilities and expanding higher education in science and engineering. These accomplishments are an important part of, and the underpinnings for, a broader effort of the European Union (EU)[1] to maintain and enhance the economic vitality of Europe. A new SRS report, *Human Resources for Science and Technology: The European Region*[2], (NSF 96-316) presents data on the rapid growth of academic degrees and R&D financial support that indicates that a high concentration of the world's scientific resources continues to reside in Europe. The growth of science and engineering resources in Asia was analyzed in a previous companion volume, *Human Resources for Science and Technology: The Asian Region* (NSF 93-303).

The increase in the awarding of natural science and engineering (NS&E) degrees by institutions in Western and Central European countries is particularly noteworthy. Over the 17-year period examined, the countries covered in the report collectively more than doubled their annual production of first university NS&E degrees. This represents a 4.5-percent average annual rate of increase in natural sciences degrees and a slightly higher rate of increase (5.0 percent) in engineering degrees.

First university degrees in NS&E fields awarded by institutions in Western and

Table 1. First university degrees in science and engineering by region

Field	United States	Europe	Asia
Total first university degrees	1,150,072	1,004,493	1,725,323
Natural science & engineering	173,099	299,057	523,651
Natural sciences	111,158	140,126	242,879
Engineering	61,941	158,931	280,772
Social science	182,166	116,353	236,018

NOTE: European region degree data include 14 countries of the European Union, as well as Norway and Switzerland, and 6 Central and Eastern European countries: Bulgaria, the Czech Republic, the Slovak Republic, Hungary, Poland, and Romania. Asian region degree data include 6 countries: China, India, Japan, S. Korea, Singapore, and Taiwan.

Regional totals are constructed from 1992 data. The requirements for first university degrees in S&E fields are not comparable across or even within the countries included in these three regions, particularly for European universities. For example, Germany submits both the university degrees (with an average duration of 7 years) and the Fachhochschulen degrees (polytechnics of 4.5 years average duration) as first university degrees (level 6 in UNESCO classification). Work has been underway for several years at UNESCO, EUROSTAT and the U.S. Department of Education to refine the levels of higher education for better comparability across countries. See for example, Mapping the World of Education: The Comparative Database system (CDS), U.S. Department of Education and the Natinal Science Foundation, Washington DC, 1994. A new UNESCO survey will be designed and implemented by the end of this decade.

SOURCE: See *Human Resources for Science & Technology: The European Region*, NSF 96-316.

[1]Figures in this data brief include the following European Union countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

[2]The countries included in the European region in this report are EU countries as well as Norway and Switzerland. Six Central European countries are included for some limited data in higher education.

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Central Europe totaled almost 300,000 in 1992, compared to 173,000 awarded by U.S. universities and colleges in that year. Table 1 shows that the European and U.S. regions would have to combine their potential human resources for science and engineering (B.S. degrees) to match those of the Asian region.

Relative to population, Western and Central European institutions are not producing more NS&E degrees than those in the United States. In 1992, 4.6 percent of the college-age cohort in the United States received an NS&E degree, compared to 4.0 percent of the European college-age population. Many European institutions' first university degrees, however, are for 6-year programs and therefore may be more comparable with a combined bachelor's and master's degree in the United States.

In addition, European and Asian institutions award a higher percentage of all their undergraduate degrees in NS&E fields than U.S. universities and colleges. About 30 percent of first university degrees awarded by institutions in EU countries are in the natural sciences and in engineering; about 15 percent of U.S. degrees are in those fields.

In 1992, doctoral degrees awarded in NS&E fields by Western and Central European institutions totaled more than 25,000, 38 percent above the U.S. level, and more than twice as many as the number recorded for Asian countries (see table 2). Like the United States, a large percentage of European doctoral degrees are earned by foreign students. For example, almost 50 percent of the degrees awarded in the United Kingdom in engineering and almost 35 percent of those awarded by French universities in the natural sciences are earned by foreign students. This high degree of foreign participation is partially attributable to the long-standing tradition of educating students from former colonial territories.

Table 2. Doctoral degrees in science and engineering, by region

Field	United States	Europe	Asia
Total science & engineering	25,184	29,540	11,767
Natural science & engineering	18,251	25,310	11,223
Natural science	12,555	18,951	6,593
Engineering	5,696	6,359	4,630
Social science	6,933	4,230	544

Regional totals are constructed from 1992 data. European data include 11 major countries: Finland, France, Germany, Hungary, Italy, the Netherlands, Norway, Poland, Sweden, Switzerland, and the United Kingdom. Asian data include 6 countries: China, India, Japan, Singapore, S.Korea and Taiwan.

SOURCE: See *Human Resources for Science & Technology: The European Region*, NSF 96-316.

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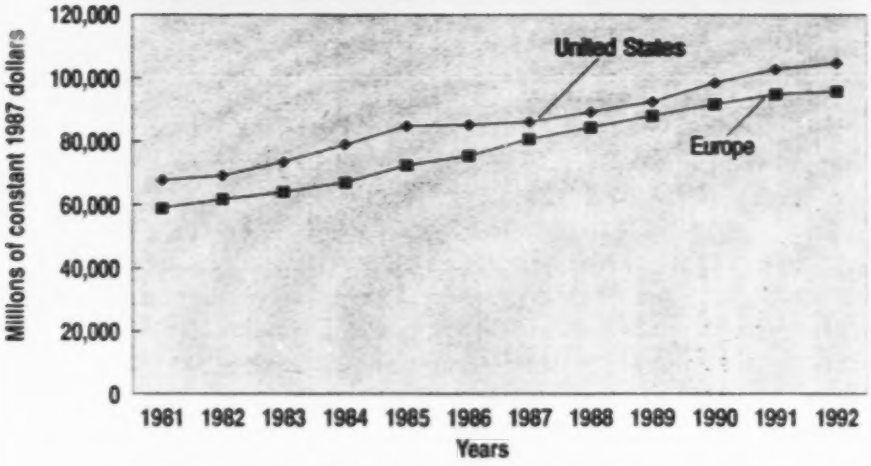
European investment in civilian research approaches that of the United States.

Figure 1. Non-defense R&D expenditures in European countries and the United States



NOTE: European R&D data include the countries of the European Union as well as Norway and Switzerland.

SOURCE: OECD *Main Science and Technology Indicators*, 1995 and NSF/SRS *National Patterns of R&D Resources: 1995*

Western European countries invested a total of $103.5 billion in R&D in 1993, compared to $137.3 billion in the United States in the same year. This represents a Western European investment of 2.1 percent of its combined GDP in R&D, compared to a U.S. investment of 2.7 percent. Western European civilian research, however, approaches that of the United States. In 1992, U.S. non-defense R&D expenditures were only 8 percent higher than those of Western Europe: $104.7 and $95.8 billion, respectively, as shown in figure 1.

In addition, the amount of funds—approximately $20 billion in 1992—spent on research performed at academic institutions in Western Europe now equals that spent at U.S. universities and colleges. Several Europe-wide programs are now in place to develop and improve S&T cooperation among the countries of the region. In particular, the EU is encouraging greater cooperation across borders to leverage S&T resources and maximize their productivity.

Implications for the United States: The total R&D performed by the European and Asian regions (each approximately $100 billion) exceeds the amount of R&D performed within the United States. Some European countries are approaching 3 percent of GDP devoted to R&D. As the capacity to perform R&D expands throughout the world, it is increasingly important for the United States to be knowledgeable about the scientific and technological accomplishments of other world regions.

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